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# *PERSONAL COOLING & WARMING SYSTEM FOR USE UNDER BODY ARMOR AND/OR CB PROTECTIVE ENSEMBLES*

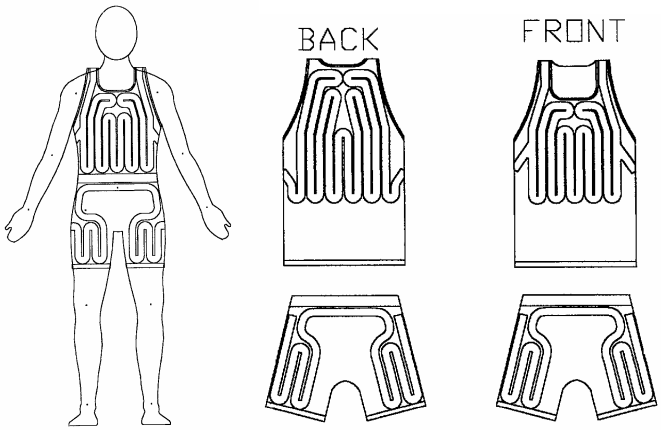
The TPI personal cooling & warming system is designed for use under body armor and/or CB protective ensembles. It is modular and completely tailorable to mission requirements. It minimizes the effects of environmental extremes and work related heat loading by actively cooling the body *and* providing chilled drinking water to the user. The system consists of vest, shorts and potentially any garment (helmet liner, etc.) connected to a temperature controlled fluid supply and conditioning system housed in a standard back-pack and integrated with a hydration (drinking) system to supply cold drinking water. The core system can be reconfigured in the field to operate as either a personal cooling or warming system for use in both extreme weather environments.

*The TPI Cooling & Warming System Is A Comfortable, Compact, Integrated Solution To Operations in Temperature Extremes.*

**The Garment**

The garment itself is based on cotton underwear fitted with a fluid bladder fabricated as a flat laminate with each channel containing a ribbon of closed cell foam. The enclosed foam ribbon minimizes 'squeeze-off' of flow caused by point pressure from the protective vests, restraint harnesses (vehicle safety belts), or tactical load carrying harnesses, etc., or from area pressure from the individual sitting or leaning against a firm surface (vehicle seat). The garment is soft, flexible and extremely comfortable.

In extreme heat load environments multiple garment elements can be worn and connected in parallel or series to increase the heat extraction capability of the cooling system. As shown, a combination of shorts and vest will provide cooling flow over most of the body's large muscle groups and major organs. A helmet liner could be added, connecting at the neck of the vest to provide cooling to the head.

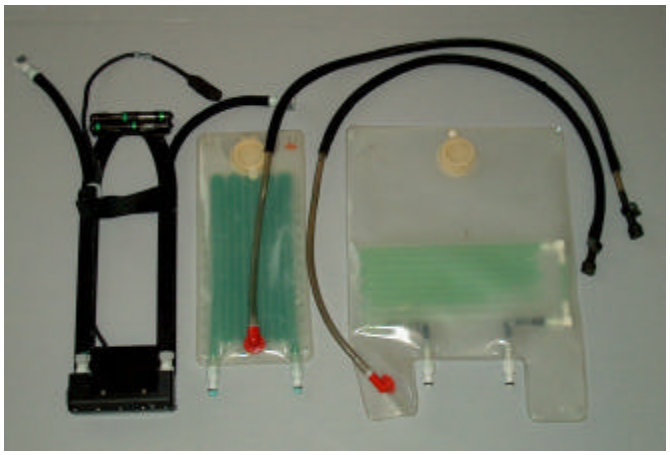



*Vest, Shorts, Even Helmet Liners Can be Added As 'Plug and Play' Elements To Tailor The System To Mission And Environmental Loading.*

**The Back-Pack**

The back pack contains the system support assembly: the pump, battery pack, control valve and heat exchange/hydration bladder. This assembly fits into a standard 100-oz hydration back-pack (such as Camel-bak, Platypus, Hydrastorm, etc.) or can be integrated into a standard combat or assault pack.

An important feature is the incorporation of the hydration (drinking) function into the cooling system. Using a large bladder (say 70 to 100-oz) could provide up to 30 to 40-oz (a quart) of cold drinking water while the remainder of the fluid continues to support the cooling function throughout the mission.



*A Variety Of Bladder Sizes Fit On A Standardized Support Frame To Cater To Different Mission Life And Hydration Requirements And Provide Cold Water For Both Cooling And Drinking.*

**System Performance**

The TPI cooling system can provide over 125-W of metabolic heat removal with just the vest. Adding shorts, helmet liner etc can increase performance to well over 200-W.

Since the system is automatically controlled to supply only the cooling/warming required the life is maximized and is inversely proportional to the heat loading. For example, a 500-Wh capacity system could extract 125-W for 4-hr or 65-W for approximately 8-hr.

The baseline system (vest, back-pack, support assembly) weighs just 3-lb dry. Total weight is a function of mission life/hydration requirements, but as a guide, a 500-Wh system (with a 4-hr mission life at 125-W) and capable of supplying up to a quart of cold drinking water without effecting cooling performance weighs less than 15-lb complete.

System power is supplied by 4xAA or 4xC cells, dependant on operational life required.

**System Advantages**

The TPI system offers the following benefits:

- an integrated cooling and hydration (with cold water) capability
- field changeable between cooling and warming effects
- fluid flow cannot be squeezed off by normal body/seat, body/harness, etc., contact
- universal inlet and outlet fittings allow maximum interchangeability with existing systems and provides ease of interface to all fluid supply systems
- elastic/cotton ‘underwear’ base fabric maximize the quality of the garment fit and hence system heat exchange efficiency and comfort.
- fluid temperature is controlled in real time to avoid the ‘too cold/too hot’ cycle associated with conventional systems and maximizes the comfort of the wearer.
- the modularity of the system allows complete mission tailoring with the addition of:
  - extra garments for increased cooling or warming capacity
  - larger support packs for extended mission life and drinking capacity
  - integration of the cooling support system into any tactical or load bearing pack as a replacement for a dedicated hydration bladder

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